



# Advanced Product Development Team Team X

Robert N. Miyake  
Jet Propulsion Laboratory  
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# Advanced Product Development Team Team X

## Agenda

- Team X Charter

- Concurrent Design Process

- Cost/Schedule Metrics

- Design Team Tools

- Distributed Concurrent Engineering (DCE) Process/Tools

- Subsystem Design Tools

- Cost Validation

- Advantages of Team X Process



## Team-X Charter

The Advanced Projects Design Team (“Team X”) was started in April of 1995.

The team was chartered to:

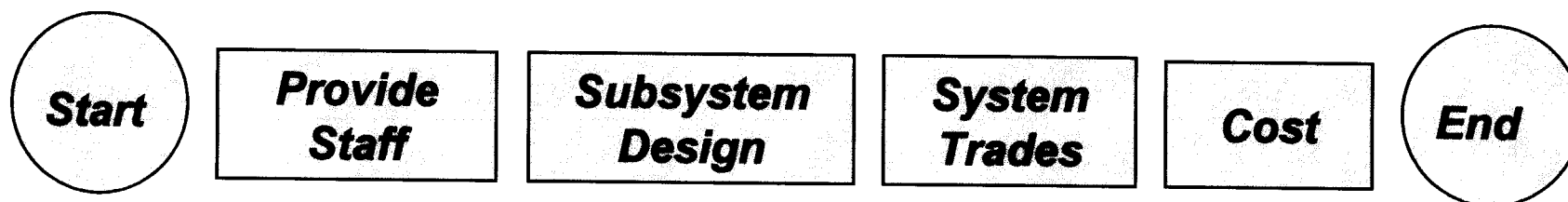
- Improve the speed and quality of JPL’s new mission concepts.
- Create a reusable study process with dedicated facilities, equipment, procedures, and tools.
- Develop a database of initial mission requirements that can be easily updated and electronically transferred for use in subsequent project phases.
- Develop mission generalists from a pool of experienced engineers.

**Over 450 completed studies to date**



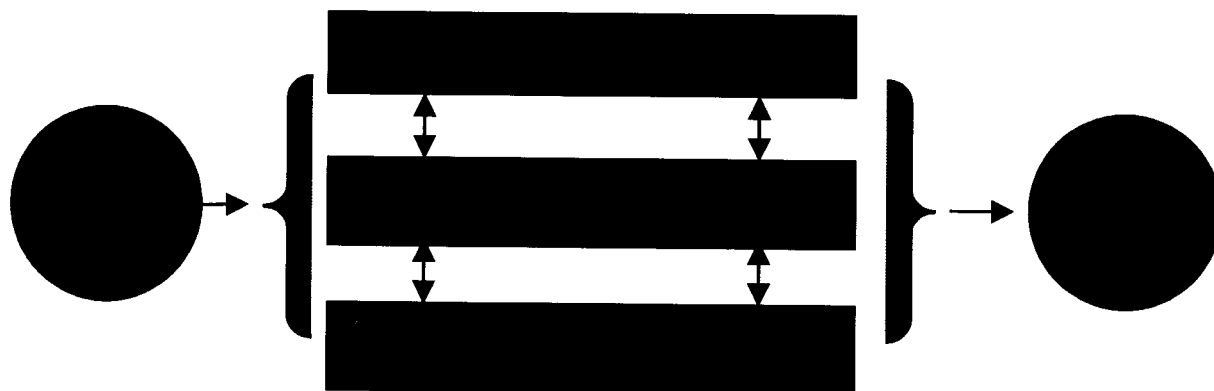
## Concurrent Design Process

### *Old Process – Sequential*



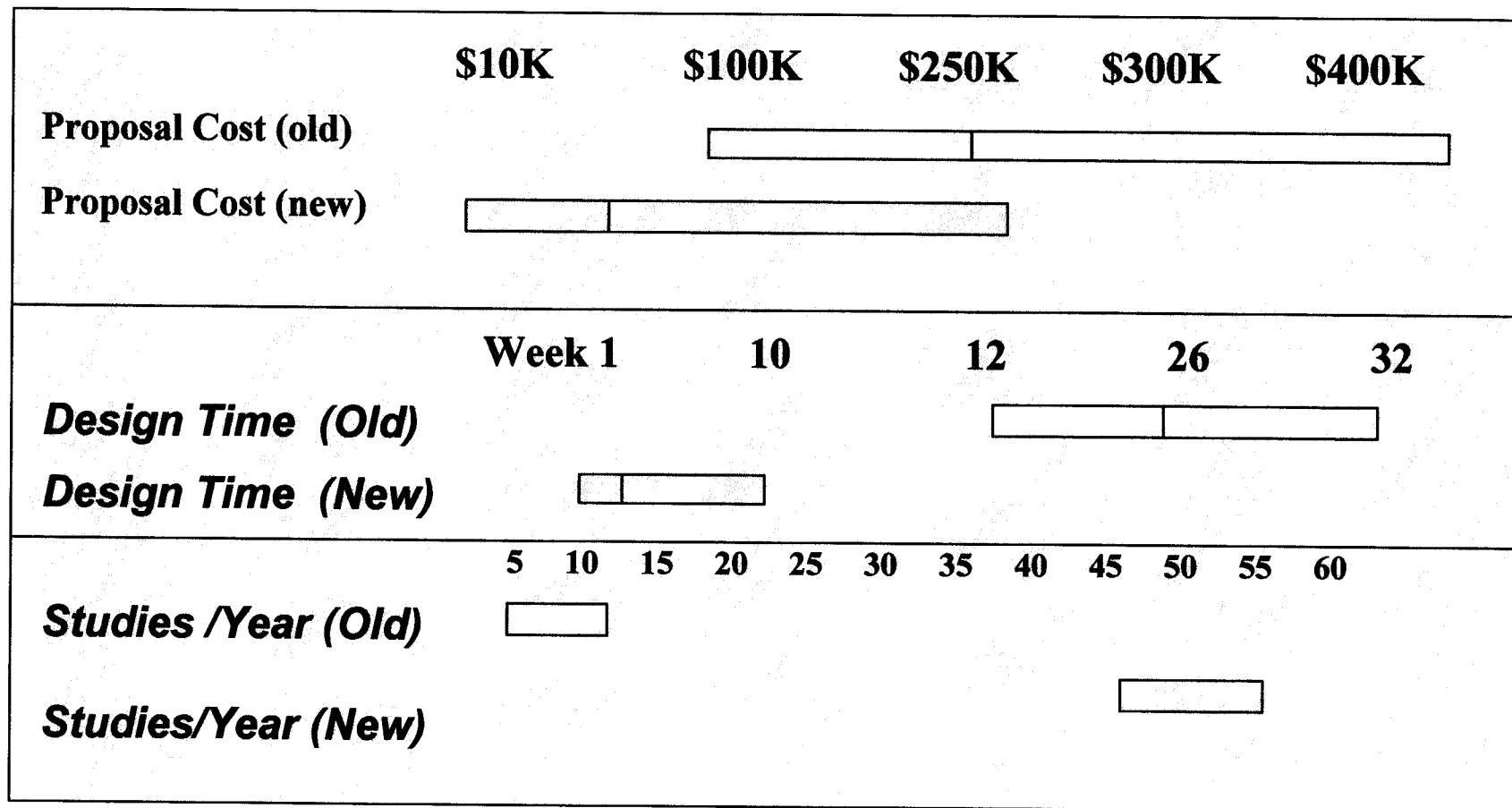
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### *New Process – Concurrent*





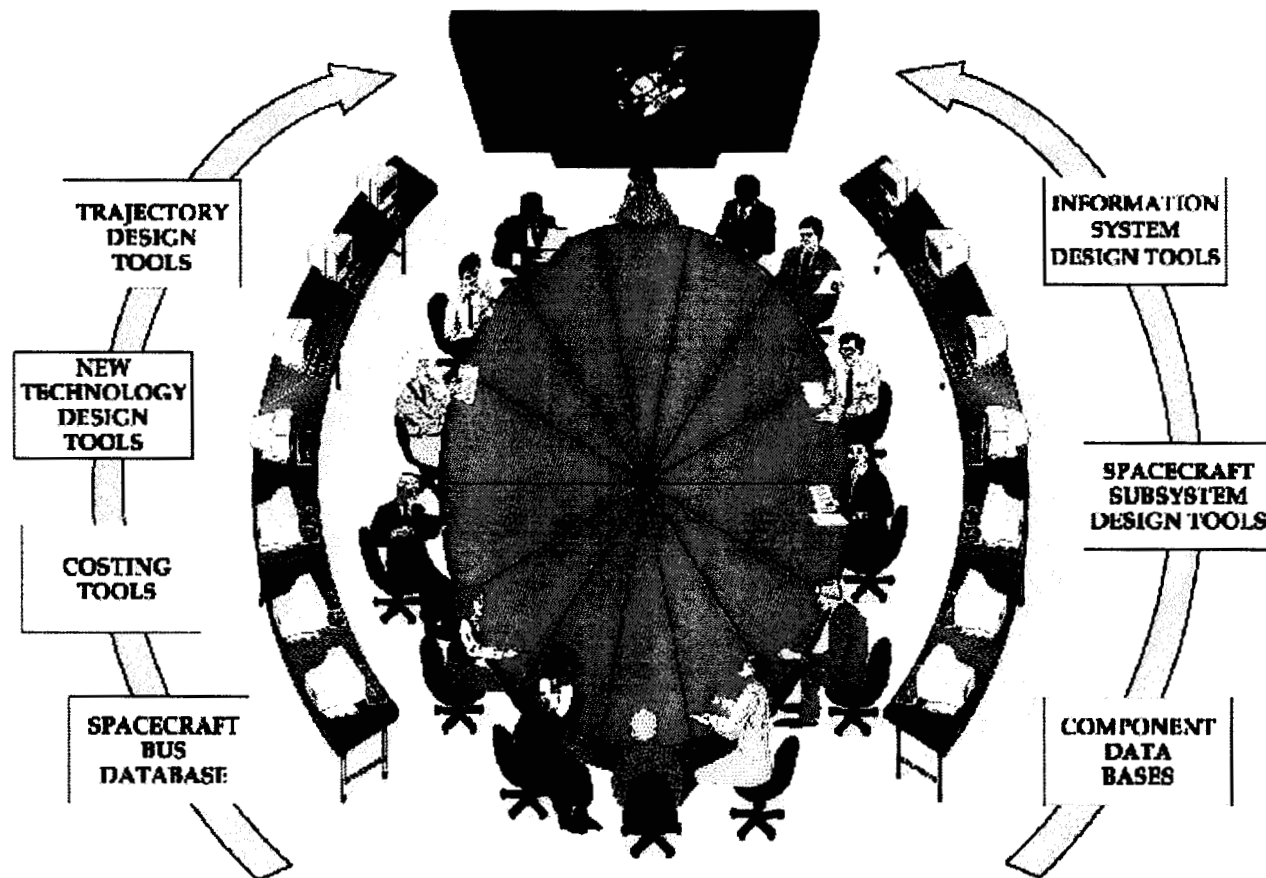
## Cost/Schedule Metrics



TEAM

JPL

## Design Team Tools





## The DCE Process

- Meet with the customer, define the study and mission objectives.
- Meet with team leaders to determine roles and responsibilities.
- Meet with the customer and a subset of the team to develop requirements and identify pre-session analyses.
- Provide top level requirements and results from pre-session analyses to the combined DCE team.



## DCE Tools

- Each team uses existing internal tools and processes with minimum modification.
- For external communication we use existing COTS tools:
  - Video teleconferencing utilizing ISDN lines.
  - Meet-me phone lines.
  - NetMeeting and/or Timbuktu application sharing software for visual data sharing.
  - VPN and/or Timbuktu to dynamically share local files.





## Subsystem Design Tools

Design tool used for the Team X studies is an Excel coupled tool.

The Excel tool for all subsystems, as well as programmatics, and systems rollup are interlinked such that an on-put from any subsystem will be routed to all subsystems to which this data is necessary to complete its function.

The reporting tool is Word, and has a notes section as well as a reporting section.



# CEM Tool



	Unit	Mass [kg]	Contingency %	CBE + Contingency [kg]	Power [W]					NASA TRL	Comments
					Science	Telecom	TCM	Cruise	Launch		
<b>TOTAL</b>		<b>7.51</b>	<b>27%</b>	<b>9.51</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>		
<b>Thermal (Spacecraft only)</b>		<b>7.44</b>		<b>7.44</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>	<b>10.1</b>		Assumes
<b>Thermal Subsystem Type</b> (Passive/Active)											
Sum of Elements to Check		7.51	27%	9.51							
Multilayer Insulation		4.52	30%	5.88							
No. of Layers (Type 1 or 2)											Type 1
Thermal Surfaces		0.16	30%	0.20							
Films											
Paints											
Tapes											
Thermal Conduction Control		0.20	30%	0.26							
Fiberglass											
Diamond											
Louvers Total Mass	0.0	0.00		0.00							
Variable Emissivity Surface (/m2)											
Thermal Radiator (Unit Area)	0.0	0.00		0.00							
Thermostats (Number)	10.0	0.50	30%	0.65							
Heaters (Number)	5.0	0.25	30%	0.33							
Heat Pipes (per 30 cm)	1.0	0.18	30%	0.23							
Passive / Variable Cond.	0.0	0.00		0.00							
Sensors											
Temperature	30.0	0.30	10%	0.33							
Others											
Sun Shade											
Aero-Shield											
Special Element											
RHU's	0.0	0.00		0.00							
Propulsion System (Inc. Thermostats)											Assumes
Tank Heaters	4.0	0.40	20%	0.48							
Line Heaters	10.0	1.00	15%	1.15							
<b>Instrument Thermal Mass/Power</b>											
Estimated Subsystem Cost (\$M FY97)	Earth				Phase A	Phase B	Phase C	Phase D			
				Workforce	0.07	0.50	0.524	0.971			
Non Rec	0.91			Dev/Test		0.1	0.3				
Red	1.731			FltHW				0.301			
				TestHW				0.25			



# Thermal Hardware List + Power



**Mission:**

**Study Name**

**Element:**

**Orbiter**

## Thermal System

### Standard Report Equipment List

ROWS, COLUMNS, AND CELLS MAY BE DELETED FOR PRINT OUT FORMATING PURPOSES WITH USERS CAN ADJUST ROW AND COLUMN WIDTHS TO THEIR OWN PREFERENCES.

<b>Subsystem Totals</b>	<b>1</b>	<b>7.510</b>	<b>20.2</b>	<b>10.1</b>
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<b>Component</b>	<b>Fit Unit s</b>	<b>Mass/ Unit (kg)</b>	<b>Total Mass (kg)</b>	<b>Peak Power per Unit (W)</b>	<b>Average Power per Unit (W)</b>
Multilayer Insulation			4.520		
Thermal Surfaces			0.160		
Thermal Conduction Control			0.200		
Louvers Total Mass	0	0.975	0.000		
Thermal Radiator (Unit Area)	0	27.000	0.000		
Heaters/Thermostats			2.150	20.2	10.1
Heat Pipes (per 30 cm)	1	0.180	0.180		
Passive Variable Cond.			0.000		
Temp Sensors			0.300		
RHU's			0.000		



# System Summary



**SYSTEMS WORKSHEET**  
Analyst: Matt Johnson  
Start Date: 2/14/1997 Directory C:\Documents and Settings\vmiyake\My Documents\

**Study Name**  
**Orbiter**

**Legend**  
Inputs from Subsystems  
Inputs from Systems  
Inputs from SOS  
Calculated

Stabilization - cruise  
Stabilization - science  
Pointing Control  
Pointing Knowledge  
Pointing Stability  
Determined by:  
Pointing Direction - cruise  
Pointing Direction - science  
Radiation Total Dose, krad  
Science BER  
Redundancy  
Mission Duration  
Max probe sun distance  
Instrument Data Rate  
Data Storage  
Maximum Link Distance  
Return Data Rate

Technology Cutoff					Return Data Rate					kb/s		
Update Now		Mass	Subsys	CBE+	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	NASA	Subsystem	Last
Update Database	Mass Fraction	(kg)	Cont. %	Cont. (kg)	Power (W)	Power (W)	Power (W)	Power (W)	Power (W)	TRL	Cost MS	Updated
<input checked="" type="checkbox"/> Save Updates All					Science	Telecom	TCM	Cruise	Launch	To-day		
Payload												
Instruments		0.0%										
Payload Total		0.0%										
Bus												
Attitude Control		0.0%										
Command & Data		0.0%										
Power		60.1%										
Propulsion1		5.2%										
Propulsion2		0.0%										
Structure		28.9%										
S/C Adapter		1.6%										
Cabling		2.5%										
Telecomm		0.0%										
Thermal		1.7%										
Bus Total												
Spacecraft Total (Dry)												Sys Mgmt&Eng.
Subsystem Heritage Contingency			20%									MechBuildUp
System Contingency			10%									Bus Cost
Spacecraft with Contingency												Bus+Inst Cost
Propellant & Pressurant		30.3%										ATLO Cost
Propellant & Pressurant		0.0%										
Spacecraft Total (Wet)												Element Cost
L/V Adapter												
Launch Mass												
												</



## Cost Validation

Validation the cost of the studies conducted by Team X as compared by actual costs.

There have been about 10 studies used in a validation evaluation.

The Team X cost variation used is +/- 30%.

Of the 10 studies used in the validation evaluation

5 were within +/- 10%

2 were within +/- 20%

2 were within +/- 30 %

Only 1 was out side the +/- 30 % , and was +34 %



## Advantages of Team-X Process

- Enables real-time design and resolution of trade issues by all team members.
  - **Allows team members to utilize tools while interacting with others**
- Allows visibility across subsystem interfaces.
- Enables early agreement and ownership of decisions by all disciplines.
- Improve quality of JPL proposals and pre-projects
  - **Facilitates assessment of cost, risk and performance**
  - **Facilitates assessment of tradeoff and descope options**
- Improves phase-A design and saves money and schedule in the design process.